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DEPARTMENT OF MINES.

GEOLOGICAL SURVEY.

BULLETIN No. 8.

**REPORT ON THE GOLD MINES AT THE
FANNING AND MOUNT SUCCESS**

(WITH MAP).

BY

WILLIAM H. RANDS, A.R.S.M., F.G.S.,

Assistant Government Geologist.

**Issued under the Authority of the Honourable Robert Philp, Minister
for Mines.**



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1898.

LETTER OF TRANSMITTAL.

THE HONOURABLE THE MINISTER FOR MINES.

Geological Survey Office,

Brisbane, 4th July, 1898.

SIR,—I beg to hand you herewith Report, by Mr. William H. Rands, on the Gold Mines of the Fanning and Mount Success, and to recommend that it be printed as a Bulletin of the Geological Survey.

I have, &c.,

ROBERT L. JACK,

Government Geologist

REPORT ON THE GOLD MINES AT THE FANNING AND MOUNT SUCCESS.

At the end of May I paid a flying visit to the Lancashire Lass and her claims at the Far Fanning, which is situated about twenty-eight miles by road in a north-westerly direction from Ravenswood Junction, and about five miles south of Dotawood Station.

The country traversed for the first sixteen miles from Ravenswood Junction consisted of granite, and was very flat, with the exception of one or two isolated hills such as those near Mount Success.

Soon after leaving the granite country, and about two miles south of the Fanning River Station, I crossed the bed of limestone described by Mr. R. L. Jack on page 2 of his Report on the "Geological Features of Part of the Coast Range between the Dalrymple and Charters Towers Road, 1879," as the base of the Lower Devonian Formation and the equivalent of the Burdekin Downs Beds. From this point to the Far Fanning wherever any rocks could be seen they consisted of hard and fine-grained greenish and brown sandstones, belonging to the same series, the last five miles of the road being very rough and rocky, and on a gradual ascent.

At the Far Fanning itself the sandstones are dipping west-south-west at from 25 to 30 degrees, the prevalent rock being a somewhat coarser sandstone with a felspathic cement or matrix.

The Far Fanning has been worked for many years past in a very desultory fashion by fossickers, but last year considerable impetus was given to the field, and there was a rush for claims and leases owing to the sale of the Lancashire Lass to a Brisbane syndicate.

I regret to say, however, that the general character of the prospecting and mining shows but little improvement, and there is a great lack of really *bonâ fide* work.

The deposits are being fossicked about in an irregular manner, and the smallness of the crushings, compared with the large faces of so-called crushing material, shows that a system of working consisting in picking out the best stone has been largely carried on.

There are two classes of deposits, one consisting of vertical or nearly vertical dykes, with leaders of quartz running through them. The dyke rock is a very much decomposed felspathic rock, probably a felsite, or belonging at any rate to the felsite-porphry class. The other consists of leaders or reefs in the country rock; these generally lie flatly, and follow more or less the bedding of the rock.

The positions of the leases and claims described below are shown on the Map attached to this Report.

The Lancashire Lass.—G.M.L. No. 383. This is a claim 400 feet by 400 feet, situated on the top of a ridge running in a nearly east and west direction. The present main working shaft is down about 60 feet in depth, and is situated about 30 to 40 feet from the western boundary of the claim. The position of this shaft evidently renders it useless as a working shaft. The outcrop of the dyke forms the highest portion of the ridge.

At the bottom of the shaft there is a wall on the south side running west 80 degrees north, and dipping steeply to the south. On this wall there is a soft "dig," and in the bottom of the shaft a highly pyritous quartz is coming in, about 2 feet wide. The width of formation, as far as it is seen in the shaft, is about 5 feet, and the other 3 feet consists of a felspathic formation with small leaders of pyritous quartz through it. These small leaders generally assume a more or less horizontal position. The northern wall has not been cut in the shaft. The first of the mundic stone appeared in the shaft at a depth of about 50 feet; above that depth the leaders consisted of both white and iron-stained quartz in the formation.

At a depth of 45 feet there is a large excavation, about 30 feet across and about 10 feet in height, on the south side of the shaft. To the north of the vertical dyke rock the sandstone is dipping slightly to the south, and through it there are leaders of quartz carrying gold. Then comes the vertical dyke rock with leaders, and also cavities or "vugs" containing gold, while to the north the horizontal rocks occur again.

A drive has been put in at this level to a shaft about 100 feet east, in which the formation is nearly vertical with a slight underlie to the south. Small leaders occur all through.

On crushing and washing some samples of quartz containing oxide of iron from the leaders, I obtained a good prospect of gold: but the formation rock gave only the very smallest colours of gold.

The following is a list of the crushings from this mine since the year 1895. I could not obtain particulars of the earlier ones:—

Date.	No. of Tons.	Yield of Gold.		Yield per Ton.	
		Oz.	dwt.	Oz.	dwt. gr.
July, 1895	18	22	0	1	4 10
September, 1895	19	31	0	1	12 15
December, 1895	14	37	0	2	12 20
May, 1896	19	31	0	1	12 15
September, 1896	43	72	0	1	13 11
November, 1896	28	42	0	1	10 0
August, 1897	35	116	0	3	6 6
December, 1897 (Crushed at Charters Towers)	32	42	0	1	10 0
May, 1898	4	4	6	1	1 12
Total	212	397	6	1	17 11

The above returns were given me by the manager of the battery on the field, at which, with the exception of the December, 1897, crushing, all the crushings took place. The average value of the gold, I am informed, is about £3 7s. per oz., varying in value between £3 and £3 17s. 6d. per oz.

The fact that, with men working on and off for three years on fair sized faces of stone, only 212 tons have been crushed shows, as I have already said, that the crushings have been carefully picked. The amount of stone left uncrushed at the surface also points to this.

The new company are, I understand, contemplating the erection of a new ten-head battery near the small creek immediately south of their claim, and with such soft stone it would take from 120 to 150 tons a week to keep the battery in full swing, and to do this the whole face will have to be taken *en masse*. There is undoubtedly a large quantity of low-grade stone, but whether it contains sufficient gold to pay is questionable.

The company will have the advantage of a mill of their own, and consequently cheaper crushing, and a large item should be saved in carting; but a very much more economical system of mining will be necessary if there is to be any chance of its paying.

A substantial looking dam was being put up in the creek, but owing, I believe, to the want of funds, the work has been stopped before its completion.

The Bank of England.—G.M.L. No. 327. Area fifteen acres. This lease lies immediately east of the Lancashire Lass. There was little or nothing to be seen here. The shaft was being sunk, and was down to a depth of 60 feet in a fine-grained sandstone, and only a few small leaders of quartz had been passed through at higher levels in the shaft. Two other shafts east of this, on the same ground, were full of water.

The Spotted Calf.—This is a claim 400 feet by 400 feet, and is also known as Macintyre's Claim. It is situated about a quarter of a mile east of the Bank of England workings. The main shaft is a little over 60 feet in depth. A few feet from the bottom of the shaft a reef 2 feet 6 inches in width comes in dipping west 25 degrees north at about 45 degrees. This is one of the most solid bodies of quartz to be seen on the field, and the 5 or 6 inches of quartz next to the footwall contains a fair percentage of pyrites. This run of stone had only just been gone through in the shaft, and there was no drive to show whether it continues any distance. Fair prospects of gold are obtained on crushing and washing.

At 48 feet in depth a small drive has been put in on what is termed a reef dipping north at 30 degrees. It is in reality a few leaders running through the country formation. Some nice prospects were obtained from some of the leaders, but some were very poor, and the stone is much mixed with formation. In a shaft a few feet to the south a similar formation was cut.

A crushing of 15 tons for 1 oz. 10 dwt. of gold per ton was, I am informed, taken from a now disused shaft west of the above. The country rock is a hardened coarse sandstone.

The Good Luck United, or No. 1 West Lancashire Lass, is a claim 500 feet by 400 feet.

At a depth of 35 feet a level has been driven in a south-easterly direction for about 50 feet in length on a very flat reef. The quartz is in bunches and veins, and is in places highly mineralised, portions being solid mundic, consisting chiefly of iron pyrites and arsenical pyrites, with small blotches of copper pyrites. The formation is about 5 feet in width. At the face of the drive, on the footwall, the reef is 2 feet in width. The reef was in the drive for the whole distance.

The following crushings were of stone taken from the drive:—

Number of Tons.		Yield.		Yield per ton.	
		Oz.	dwt.	Oz.	dwt. gr.
7	(Treated at Aldershot) ...	15	8	2	4 0
40	62	0	1	11 0
40	(Brown Stone)	20	0	0	10 0
14	28	0	2	0 0
3	19	4	6	8 0
13	(Top Formation)	8	9	0	13 0
Total 117 tons		152	17	1	6 3

At the time of my visit there were about 30 tons of good-looking stone in the paddock.

In the western drive the reef is much smaller, there being only 3 to 4 inches of mundic stone on the footwall, but small veinlets run through the formation, and veins also go into the footwall. Near the bottom of the underlie shaft, below the level, the reef is very small, but it appears to be increasing a little in size in the bottom. The country rock is a somewhat fine-grained sandstone, dipping south-west at 30 degrees.

Tunnelling Area.—This is situated about 12 chains west of the Lancashire Lass.

There was not much to be seen here, though a considerable amount of work has been done on the ground.

No one was at work at the time of my visit. A tunnel is being driven from a gully in a southerly direction into the hill, from which I was informed some mundic stone was taken.

An old underlie shaft was sunk to a considerable depth on the top of the ridge on a formation running north and south and dipping west, but it had fallen in and I could obtain no information about it. This was by far the deepest shaft on the field. The sandstones here are dipping south 25 degrees west at 28 degrees.

From open workings above the tunnel some 300 tons of stone were crushed for an average yield of 5 dwt. of gold per ton, worth £3 10s. per oz.

The Union.—This lies 250 yards to the west of the Tunnelling Area. Interbedded with the sandstones is a dark-coloured sandy shale. At the surface the stone was worked out in a face, and 150 tons are reported to have gone 10 dwt. of gold to the ton.

A shaft is down 70 feet, but so far nothing has been met with except a few small quartz leaders from 1 to 4 inches in width in the sandstone. These run east and west, and some small parallel leaders were worked about a chain to the north.

The Kitty O'Shea.—This claim is situated about one and a-half to two miles west of north of the above claims.

Here a small vein about 2 inches wide was cut at 15 feet in depth, and had been followed down to the north-north-east on the underlie for about 8 feet. The country consists of shaley sandstone and greywacke.

An old underlie shaft, said to be about 100 feet in depth, is situated close to this shaft. Two crushings were taken from this. The first went 19 dwt. of gold per ton, and the second 22 dwt. of gold per ton. The reef in this was said to be 8 inches wide.

Just north of the shaft there is an open working from which 12 tons were taken which yielded 10 dwt. of gold per ton.

From this point Dotswood Hill could be plainly seen with its escarpments of sandstone which is dipping in a northerly direction.

Mount Hogan is the name of a claim about a mile south of the above and half-a-mile north of the battery. No work beyond trenching had been done, and the stone from an open cutting crushed 5 dwt. of gold per ton. Alluvial gold was worked in a gully 200 yards west of this.

Battery.—There is a small four-head battery on Arthur's Creek, about a mile to the west of the Lancashire Lass, where a small dam has been erected to conserve the water. A syndicate is now treating the old tailings from this battery by the cyanide process, and Mr. Peek, the manager of the plant, says that he is getting up to 5 dwt. of gold per ton, showing that the battery lost a good deal of the gold.

From the above descriptions of the workings it will be gathered that so far nothing very definite has been found, and that the workings have not got far enough to give much idea of the future value of the deposits. Prospecting has gone sufficiently far to prove the existence of what may be looked upon as low-grade deposits, but as the crushings have been chiefly picked from the richer portions, it would be unwise to hazard what the stone would go when taken right through, as will be necessary when a large battery has to be kept constantly at work. The sulphuret ores are just commencing to appear in several of the claims, and, except in the case of No. 1 West Lancashire Lass, where good returns have been obtained from small parcels, very little is known about them, but from their character I do not anticipate there will be any great difficulty in their treatment.

Now that there appears to be a chance of some of the claims being worked by companies or syndicates, it is to be hoped that vigorous and intelligent work will be carried on. If there is to be any chance of their paying, the mines will have to be opened up in a manner which will allow of the ore being easily raised, for most of the present shafts are unfit for working shafts, and every economy in the direction of labour-saving machinery will have to be used, while carting and such like expenses must be reduced to a minimum.

It is not unlikely from the character of the deposits that some little difficulty may be found in following the auriferous portions.

MOUNT SUCCESS.

On my return from the Far Fanning, I visited the Mount Success Camp, which lies about fifteen miles west-north-west of Ravenswood Junction.

This opened early in the year 1895 as an alluvial field, but the alluvial gold from the gullies was soon worked out. Later on in the year, the Mount Success Reef was found, which at first yielded about 3 oz. of gold per ton, but the returns rapidly fell off. Unfortunately the whole of the mines were either abandoned or under exemption, and I found it impossible to get down any of them.*

I saw some very heavily mineralised stone from one of the shafts, consisting chiefly of zincblende (Black Jack), and crystallised iron pyrites.

The Golden Valley Reef is about a mile from the Mount Success Reef. The reef is situated low down in the valley of a creek which empties itself into the Fanning River about six miles below the station. The reef is small, but the yields have been good.

* I am informed that Craven's Mount Success is at work again, and is turning out large quantities of good stone.

Golden Valley P.O.—The Golden Valley Reef runs east and west and underlies very flatly to the south. The mine is worked by means of an underlie shaft from the surface. At 50 feet down the underlie a level has been driven for 80 feet in an easterly direction. A good reef was in the level for 55 feet from the shaft, when a fault came in running north-west and dipping south-west, which cut it off. Above this level the reef had been stoped out to the surface, chiefly on brown oxidised stone. The hanging-wall is a fine-grained felsitic rock, and the footwall is a granite. The average width of the reef was 6 inches. The reef averaged about 2 oz. of gold per ton, in addition to which the concentrates sold for £14 per ton.

A level has been driven to the west, and the reef was being worked out above it.

The reef consists of quartz with a felspathic matrix. The quartz contains a very large percentage of zincblende and iron pyrites, with small veins and patches of calcite through it, and where they occur the richest gold is generally obtained. The sulphuret minerals are now being concentrated and sent to the Charters Towers Pyrites Works for treatment.

The stone is of very good quality, but expensive to work on account of its small size, but should it increase at all it should be a good payable reef. Some of the shafts on the line lie very low, and are liable to be flooded.

The Golden Valley Block.—The shaft is situated about 500 feet south of the Golden Valley P.C. Shaft, and close to the boundary of that claim. The claim was under exemption at the time of my visit. The shaft is a vertical one, and I was informed that it cut a leader 7 inches thick at 90 feet, a formation of from 18 inches to 2 feet thick at 110 feet, and finally reef and formation 3 feet 9 inches wide at 170 feet.

Golden Valley No. 1 East.—This was also under exemption, and I could not get down. The last crushing was one of 25 tons, which went 14 dwt. of gold per ton.

Golden Valley No. 1 West.—In their new shaft a small reef was cut at 45 feet in depth, running east and west, and dipping south. Drives are being put in to the east and west on a very small reef, only about 2 to 3 inches in width, which is in places very mullocky. The quartz contains zincblende and pyrites. In the old shaft about half-a-chain to the north the reef was 6 inches wide, and crushed $4\frac{1}{2}$ oz. of gold per ton.

Golden Valley No. 2 West.—The reef was cut at 40 feet in depth. It was very small, and was just being opened out on.

There are two batteries on the field, one a five-stamp battery, erected by Mr. Craven near the Mount Success to test that reef, and the other a ten-stamp battery erected by Mr. Ball.

WILLIAM H. RANDS.



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DEPARTMENT OF MINES.

GEOLOGICAL SURVEY

BULLETIN No. 9.

[*Publication no. 134*]

REPORT

TO

THE HONOURABLE THE MINISTER FOR MINES

ON THE

CHILLAGOE MINING DISTRICT AND PROJECTED RAILWAY.

BY

ROBERT L. JACK, F.G.S., F.R.G.S.,

Government Geologist.

Issued under the Authority of the Honourable Robert Philp, Minister
for Mines.



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REPORT TO THE HONOURABLE THE MINISTER FOR MINES ON THE CHILLAGOE MINING DISTRICT AND PROJECTED RAILWAY.

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Acting under your instructions, I visited the mining district of Chillagoe and the region lying between it and the Etheridge Gold Field, for the purpose of reporting on the prospects of the railway, and, conversely, on the influence of the railway on the mines. I was on the ground only from 21st May to 10th June, so that it was impossible, considering the extent of the country traversed, to examine everything minutely. The following Report, therefore, deals rather with impressions and general questions than with details.

Towards the end of the year 1890, I visited the same district, and made a report on the mines as they then appeared.* It may be pointed out that less prominence was given in that report to copper than to silver, for the reason that at that time, as well as for years before and years after, the former metal was not in great demand, and many mines of importance all over the colony were lying idle. Enough, however, was said to show that copper ores were abundant in the Chillagoe district.

Mr. Sydney B. J. Skertchly, then Assistant Geologist, again visited the district between July and November, 1895, and made a report which was published in 1897†.

In my 1891 Report I mapped the sedimentary rocks of the Chillagoe district (limestones, mica-schists, garnet-rock, &c.) as "Carboniferous," as what little evidence there was seemed to point to their being low in the Permo-Carboniferous system. Since then, however, palæontological evidence has come to light which proves that they are on a lower horizon—viz., Devonian—i.e., they are equivalent to what were provisionally named the "Burdekin Beds." The difference is not merely of scientific interest, but has an economic side as well, seeing that many of the best-known metalliferous deposits of the world are of Devonian age. The 1892 Report concluded with the expression of my opinion that "the district bids fair, in the near future, to rival or excel the richest of our mineral fields. Some of the deposits of silver and copper ore are on a gigantic scale. . . . The chances are all in favour of the mines from which ore can be raised in large quantities." Such work as has been done since 1891 tends to strengthen the opinion then formed. Some mines have even turned out better than their surface appearance led me to expect. For instance, in the case of the Ruddygore, I spoke of a projecting mass 60 feet long, 40 feet wide, and 30 feet high, as looking from a distance like a solid mass of malachite, "but when seen closely it appears that the rich green colour is a mere coat of paint, generally lining soft cavities which are set in a framework of harder ferruginous material." I added:—"the rock is a decomposing dyke of porphyry. . . . A

* Report on the Chillagoe and Koorboora Mining Districts. Brisbane: By Authority, 1891.

† Report on the Tin Mines of Watsonville, and various Tin, Silver, Copper and Gold Mines at Herberton, Montalbion, Muldiva, Calcifer, Chillagoe, California Creek, the Tate River, &c. Brisbane: By Authority, 1897.

tunnel has been driven for 9 yards to the south-east, in continuation of an open cutting 50 feet in length. . . . In both the cutting and the tunnel, lumps of carbonate of copper occur in places, but for the most part nothing is seen in the tunnel but the porphyry, which is much less copper-stained than the outside of the rock." The by no means sanguine view of the prospects of the mine above quoted may be contrasted with the fact that it has paid to remove the projecting mass in a body for the sake of the ore it contained, and that its site is marked by a quarry large enough to have buried it in. Again, in the Griffith Mine, the lode in the "Magazine Face," described in the same Report as varying from 1 to 8 feet in thickness, has been opened up for a length of about 150 feet, and to a level of about 30 feet below that where I previously saw it, and is larger than ever at the two ends; in fact, as the terminal sections show, an accumulation of surface soil alone prevents its being traced further in both directions, as no doubt it will be in the near future.

There are smelters at Calcifer and Girofla, and it has been said that the fact that these have not been constantly at work argues that a sufficient quantity of ore was not procurable in the district. Nothing could be further from the fact. Thousands of tons of good ore are lying at grass, but I am informed that the carrying capacity of the district was unable to overtake the product of a prolonged "run" of the furnaces, while the high rate of carriage by drays or packhorses made it unprofitable to smelt anything but picked ore. Given a hard-and-fast limit to the transit of furnace products, would any mineowner possessed of brains raise and smelt more second-class ore than he could help?

The fact that only one class of ore was wanted under the conditions forced upon the owners by the high price of carriage has had a noticeable effect on the system of mining employed up to the present. To an observer who was not aware of these conditions it would appear that the ore-bodies were such as only to admit of mining of the character usually described as "fossicking." I am convinced, however, that with the advent of railway facilities—meaning cheaper fuel, machinery, &c., as well as more economical access to the markets for the products of the smelters—there is enough of ore to keep a large smelting plant in full operation, and to keep the railway busy in fetching and carrying.

In my Report of 1891 I referred to two instances (Girofla and Griffith) in which it seemed to me that the ore-bodies were probably deposits in caverns in the limestone, or at least were not "fissure-lodes" in the usual sense of the term. It has come to my knowledge that the term "cave deposit" has proved of alarming import to miners accustomed only to lodes, as well as to individuals unfamiliar with the general occurrence of ore-bodies. Some of the greatest known ore-bodies are not defined between the two walls of a fissure, but are portions of country-rock impregnated with, or more or less replaced by, ores of the metals which are required in human industry. What constitutes the difference between limestones and sedimentary rocks of mere clastic or mechanical origin is their greater solubility. Large bodies of limestone may be entirely removed to make room for metallic deposits, while sandstones, greywackes, &c., may be only partially dissolved and permeated by veins or reduced to a skeleton. In all

parts of the world cavities in limestone country have yielded enormous quantities of cheaply won and easily smelted ores. From the almost interminable list of mines which are not fissure-lodes, but impregnations or replacements of mechanically or chemically formed sedimentary rocks, I may quote Mount Morgan in Queensland, Burra-Burra in South Australia, Mount Lyell and Mount Bischoff in Tasmania, Pary's Mountain in Wales, Rio Tinto and Tharsis in Spain, and Potosi in Bolivia, as examples.

A careful perusal of my previous report, as well as of the descriptions which follow, will suffice to show that I never meant to imply that all or even a large proportion of the Chillagoe mines were on "cave deposits." Many of them are on "fissure-lodes" within the strictest definition of the term, and some are "stockwerks." The Ruddygore, for example, belongs to the latter class, which elsewhere has proved a most fertile source of payable ore.

In 1890, when I first visited the district, copper mining, as already mentioned, was subordinated to silver mining, and it had not been realised, as it has since the demand for copper began, that silver occurred as a rule in combination with the copper ores of Chillagoe. The proportion of silver varies considerably, as might have been expected, but in some of the leases the proportion is so great as to make it certain that the copper produced will be distinctly an argentiferous one. In addition, a little gold is almost always present in the copper ores. The occurrence of silver and gold has a distinct bearing on the metallurgical aspect of the question.

Where copper is found free from such impurities as gold and silver, a tedious and complex metallurgical process is necessary before it becomes a marketable article; and antimony, zinc, lead, arsenic, and bismuth generally add to the trouble and expense; but when gold or silver is present—or both—the scheme of treatment is simplified. The blast furnace is used to make a rich matte. The converter follows, and makes "black" or "blister" copper, which is then refined electrolytically. In this process not only are the gold and silver recovered, but the objectionable elements mentioned above are simultaneously removed without additional expense.

I have just seen the Report on the Chillagoe Mines by Mr. Alex. Stewart, General Manager of the Broken Hill Proprietary Company. The report deals with the mines, as well as with the railway and other projects of the Company, and is accompanied by plans which graphically portray the magnitude of the ore deposits. I am glad to find that my views of the value of the mining properties are in accord with those of such a high authority. My opinion is that the mines amply justify the expenditure of the necessary capital in the construction of a railway, smelting works, and electrolytic refinery. The mines could never be satisfactorily developed without the railway, nor would the railway be a paying concern without the mines. Once built, however, there are some items of additional revenue for the railway which may be briefly referred to in this place.

The settlement of a mining population will lead to a passenger traffic of considerable dimensions, and all the necessaries of life for the industrial settlers will have to be carried along the whole line. The eastern end of the line will supply the western with building material, and, to a large extent, with foodstuffs, fruit, and fodder. A tourist

traffic will probably be attracted by the wonderfully picturesque caves in the Chillagoe limestone. Cattle raised on the western stations will be trucked along the whole length of the line to the meatworks at Bibbohra, to avoid the loss of condition which would result from "travelling" them to the market. Mining machinery will for some time form an important part of the "up" loading. There is no reason why such machinery should not be manufactured near the eastern terminus of the line, and it will doubtless be the Company's policy to foster such an industry.

The staple traffic of the line will, of course, be minerals. In place of having reduction works at each of the groups of mines, a vast economy will be effected by transporting the ores of every class to central works. The Company's own mines will send all their ores to such works, while fluxes in the shape of limestone and ironstone are present in unlimited quantities in such positions that they practically will only require to be broken down and loaded into the trucks. If the Company's works become, as they should, the great centre of metallurgical operations for the North of Queensland, a considerable traffic in ores carried by sea to Cairns might even add to the earnings of the railway, and of course to the earnings of the Government line from Cairns to Mareeba.

As regards the construction of the railway, it would be easy for a stranger travelling in a coach along the bush track to imagine, from the way in which he is bumped and jolted over stones and ruts, that the country is unsuitable for a railway. But the country is not a mountainous one. On the contrary, it is an elevated plateau, the difficulties of ascending to which have all been overcome by the Government railway already built. It presents, so far as I can see, no engineering difficulties. I understand that Mr. A. S. Frew, the engineer in charge of the surveys, has estimated the cost of construction at about £3,072 per mile.

My instructions permitted me to visit the "outside" mines, for the purpose of judging of their influence upon the railway, and, conversely, of the effect of the railway upon their development. There will obviously drain into the line—from the north, the silver, lead, copper, and wolfram mines of Lappa Lappa, and the tin mines of Koorboora; from the west and north-west, the copper and silver mines of Ashtonville and Arbouin; and from the south, the tin mines of Irvinebank and the Orient, the silver and lead mines of Montalbion and Silverfield, the tin mines of Emu and California Creeks, the lead and silver mines of Muldiva and Dargalong, and the tin mines of the Tate. In anticipation of the building of the railway, many leases have been taken up on copper "shows," and some of them which I have seen may be relied upon to contribute no inconsiderable amount of mineral traffic.

The copper district of Arbouin* is about 23 miles west-north-west of the terminus of the Chillagoe Railway survey, by a road which is all "plain sailing" from an engineering point of view. I am convinced that it will be a valuable contributor of mineral traffic to the railway from the moment when the latter is brought within its reach. The extension of the railway to Arbouin will doubtless be demanded at the earliest possible time, as without railway construction the mines

* Known (unofficially) for a time as Klondyke, and afterwards as Bedford.

can only be worked under needlessly uphill conditions, and consequently on a comparatively small scale. Without entering into details in this place, I may say that the ore deposits in this locality evidently occur in true lodes, which are exceptionally wide and persistent, and show on the surface a quite unusually large quantity of copper ore. The caps of the lodes, moreover, invariably yield a fair prospect of gold. I cannot pretend to estimate the gold-contents, but I believe that there is enough to be a distinct advantage in a milling ore, and to prove most welcome at the smelting works.

The Mount Garnet Mine is about 27 miles south-east of the nearest point of the Chillagoe Railway survey, and I refer to it in this place as an instance of the advantage that it and the trunk railway would derive from the construction of a branch line. I was much struck with the magnitude of the lode and the richness of the ores, both in copper and silver. By "richness," I mean, of course, relatively to the quantity of ore, the cost of mining, and the probable, or at least possible, extent of the Company's operations. The bulk of the ore passed through may be averaged at 10 per cent. of copper, and the silver at the rate of 15 oz. to the ton. From a narrow lode this would not be rich, but a tunnel shows the ore-body to be at least 60 feet wide, and the outcrop is well marked, and visible for about three-quarters of a mile. A railway from, say, Wade's, or Koorboora to Mount Garnet would traverse a stanniferous district at present greatly neglected owing to the low price of tin. Without a railway, the heavy charges of dray traffic would seriously restrict the output of Mount Garnet, and once loaded on drays the products of the mine would probably go direct to the terminus of the Government line at Mareeba.

The extensive and rich Etheridge Gold Field has hitherto been worked under exceptional difficulties, chief among which has always been the want of railway communication. The nature of the auriferous ore itself offers a difficulty scarcely less formidable. But the complex sulphide ores could not only be treated with ease if mixed with the metallic ores of Chillagoe, but would actually, owing to their gold contents, be a valuable acquisition to the works. The freight charges to the works would be very much less than the cost of local treatment—that is, of a treatment equal to the full extraction of the gold. At present, local treatment is not only costly, but is chargeable with the loss of a large percentage of gold.

As the westmost portion of the Chillagoe Railway takes a north-westerly course, for the purpose of "threading-on" the Company's groups of mines, it would not be advisable to start a line for Georgetown from the terminus, as that would involve an unnecessary toll of about 8d. (16 miles at $\frac{1}{2}$ d.) on every ton carried. From a point near Mount Lucy, the distance to Georgetown, as the crow flies, is 96 miles. The route over which the Railway Commissioner lately travelled in a buggy—viz., *vid* Muldiva, the Tate Telegraph Station, and Dagworth—is nearly on this line; perhaps 10 miles may have to be added for its deviation from a direct course. It is, moreover, probably more free of engineering difficulties than any other; but, so far as I know, after leaving the Tate it does not pass through mineral country. On the other hand, a route from Mount Lucy, *vid* Muldiva, Fossil Brook (the township), and Quartz Hill, and thence by the Herberton-Georgetown coach road to Georgetown,

though more difficult, would pass near enough to known mineral lands to draw a substantial revenue from them, in addition to the through traffic from Georgetown. On the north-west side of this route there are the tin mines of the Fulford and Lancewood. I also heard of a copper outcrop near Fossil Brook, and saw numerous outcrops of copper and silver-bearing lodes between Brooklands Station and the mouth of Junction Creek, which, if they come to anything, will be very convenient to the line. On the south-east side, the great copper mine at the junction of the Einasleigh and Copperfield Rivers will be within 28 miles of the railway, and there is little doubt that if this line were built the products of the mine would be trucked to central works rather than treated on the spot. This mine has been known since 1867, when the Rev. W. B. Clarke communicated Mr. Richard Daintree's account of it to the Royal Society of New South Wales. The lode crops out between the normal level and the flood level of the river. The cap is visible for about 180 feet, and I judge it to be about 40 feet in width. The surface ores I should estimate to go from 10 to 12 per cent. of copper. At one end, the lode disappears under the cake of basalt which, with a thickness of 30 or 40 feet, covers the flat on the left or western bank of the river. Daintree mentions that a shaft was sunk on it to a depth of 80 feet, and that a drive at that level showed the lode to be 28 feet wide and to consist of "spongy metallic copper." I could see nothing of the shaft, which has probably by this time fallen in and been covered by flood drift.

A railway already connects the port of Normanton, on the Gulf of Carpentaria, with the Croydon Gold Field, and there can be no doubt that the moment railway connection between Georgetown and Cairns is achieved, the public interests will demand the speedy completion of the remaining link—from Croydon to Georgetown, 105 miles—between the Pacific and the Gulf. The connection of Croydon and Georgetown would be simplicity itself in an engineering sense, and is already a project favoured by the community of Normanton and Croydon. It is quite possible that it may be accomplished in the near future, or at any rate before Georgetown is connected with Cairns, and the possible effect of such a connection must be taken into account.

Although, in the case supposed, all the supplies for the Etheridge would come from Croydon by rail, as they do now (for the most part) by wagons, nothing but the gold would return. There is no reason why Etheridge mineowners should send their ores to Croydon for treatment. Passenger traffic from Georgetown to Normanton, even if established by the opening of a line from Croydon to Georgetown, would be diverted to Cairns as soon as railway communication with that port was open.

I learn that an engineer with a high reputation has been examining the Barron Falls with a view to reporting on the amount of power available. There is no doubt in my mind in this magnificent body of water lies, most conveniently placed by Nature, a potent factor in making the great undertaking of the Company a commercial success. The importance of a large and readily available water power in electrolytic refining is self-evident, and I expect that the engineer will be able to report that the profits on the work, under the favourable conditions here present, will more than justify the expenditure of the necessary capital.

The smelting works will have of necessity to import large quantities of coal and coke from the South, most likely from Burrum or Ipswich, and the market thus created will be a direct benefit to the producers, to the shippers, and to the Government railways.

With my Report of 1891 there was issued a map (No. 1) of the Chillagoe and Koorboora Districts. Since then the surveys of the Lands Department have furnished a ring of traverses by the aid of which I am enabled to correct the portion which in 1891 was only sketched. The map, with these additions, is appended to this Report because, however imperfect, there is no better available at present for the use of the travelling and prospecting public. The leases and the projected railway are added from the plans accompanying Mr. Stewart's Report.

A systematic geological survey of the district will have to be set on foot as early as possible, and, as a preliminary to this work, Mr. E. C. Owen, Topographer to the Geological Survey, is now in the field making a topographical map.

The following are my notes on the mines visited during my recent tour:—

A FEW OF THE CHILLAGOE MINES.

Oruba.—This mine lies about two miles east of Zillmanton, on the south side of the road. There is a large east and west outcrop of siliceous stone, with a shaft and cutting on the eastern end, and a cutting across the outcrop $2\frac{1}{2}$ chains west of the shaft. The shaft is about 20 feet deep, and is sunk in quartzite country outside of the lode. Some of the material here (from the cutting) is almost a copper ore. The cutting $2\frac{1}{2}$ chains west of the shaft shows the lode to be about 20 feet across.

On the north side of the road, about a quarter of a mile from the outcrop already mentioned, is another, which is from 20 to 30 feet wide, partly of pure iron glance and partly of siliceous iron glance, sometimes showing carbonate of copper. It runs N. 30 degrees W. (magnetic). Some trenches show a good deal of dark copper sulphides. A shaft has been sunk about 60 (?) feet in soft decomposing granite, which rock and limestone are seen all around in the vicinity of the shaft. There appears to be a mass of lodes all the way from this point to the lode on the south side of the road. One rock stands up about 8 feet above the ground and is half limestone and half iron-stone.

Atherton.—This lease, which is numbered 34, is on the south side of the road, east of the *Otho Camp*. It is a true lode and runs west-north-west, and is 10 feet or more in width. It has an open cutting which follows the line of the lode for about 40 feet, and a shaft about 15 feet deep. The ore is siliceous and ferruginous. One heap measures 30 x 12 x 6 feet; another, of "seconds," is 30 x 12 x 4 feet. The latter, Mr. Linedale informs me, assays 20 oz. of silver per ton. My description of this mine in the 1891 Report was as follows:—

"A 5-acre lease (No. 429). The country rock is quartzite, between two masses of limestone. The cap can be followed north-west and south-east for a distance of about a quarter of a mile, and is at least 20 feet wide. Towards the north-west it is hard and siliceous. About 160 tons of ore have been raised from the open workings. The ore is soft. The gangue is partly siliceous and

partly felspathic, with green stains of carbonate of copper, intensified on joints and spots to films and masses of soft ferruginous red oxide of copper."

Otho. Lease 32.—Parts of this long lode were formerly known as the "O'Hara Copper" and the "O'Hara Lead" (Silver Lead).^{*} The part I saw was in a flat, where there is a large open cutting at least 20 feet wide. Although no walls are visible there are large quantities of hard siliceous ore. One heap of greenish carbonate of copper and lead, measuring about 15 x 16 x 3 feet, gives over 100 oz. of silver per ton. Another heap, 15 x 15 x 3 feet, is mainly of lead carbonate, but is said to be poorer in silver than the copper ore. Although no outcrop is visible on the flat, the cap of the lode is traceable for a long distance to north-west and south-east among the hills.

P.P.A. No. 2 (Otho Camp).—This lode runs west-north-west, and stands from 50 to 100 feet above the general level of the surrounding country. On its north side there is limestone, and on its south side syenite. The "Cathedral Rock" (limestone) lies about a quarter of a mile to the south, with granite (or syenite) in the intervening low country.

The cap of the lode is ferruginous and siliceous, with carbonate of copper showing in many places. A cutting is being put in across the cap. From this cutting a quantity of good ore has been taken. One heap, 35 x 12 x 6 feet, is a "grey ore" (sulphide) mixed with carbonate of copper.

Ruddygore.—This mine is about 3 miles north of the *Otho Camp*, and was described in my 1891 Report as follows:—

"In granite country. The chief working is on a mass which projects above the level of the surrounding country, and may be roughly estimated at 60 feet long, 40 feet wide, and 30 feet high. From a distance it looks like a solid mass of malachite, but when seen closely it appears that the rich green colour is a mere coat of paint, generally lining soft cavities which are set in a frame-work of harder ferruginous material. The rock is a decomposing dyke of porphyry, in which felspar and quartz are the only recognisable constituents, the felspar weathering in places to kaolin. A tunnel has been driven for 9 yards to the south-east in continuation of an open cutting, 50 feet in length, commencing at the left bank of a gully. In both the cutting and the tunnel lumps of carbonate of copper occur in places, but for the most part nothing is seen in the tunnel but the porphyry, which is much less copper-stained than the outside of the rock. The ore stacked is said to vary from 30 per cent. to 9 per cent. of copper. It is a mixture of red oxide of copper, 'tile ore' (red ferruginous copper oxide), 'grey ore,' and green carbonate of copper with red iron oxide. Here and there fine needles of atacamite are seen lining geodes. This lode or dyke is traceable across the hill to the south-east for nearly half a mile. In several small openings a little carbonate of copper is seen. It can also be traced to the north-west for about a quarter of a mile."

The whole of the projecting mass has now been removed, and the workings have reached, in a large quarry, to a level of nearly 50 feet below the gully, which has been diverted by a deep trench. The

^{*} See Geological sketch map with Mr. Skertchly's Report of 1896.

quarry shows a porphyry impregnated with copper ore, especially in the neighbourhood of joints and fissures, which are probably faults. (*See Mr. Skertchly's Report of 1896.*) I saw some large pockets of iron and copper pyrites and some erubescite. There are said to have been large masses of black copper sulphide in the quarry. Unfortunately I could not see the bottom, in which water was standing owing to a recent shower.

Queenslander.—On the south-south-west side of the "cap of a lode which is very persistent for about half-a-mile, in a west-north-west direction," mentioned in my description of Prospecting Area No. 8, written in 1891, a shaft has been sunk to the depth of 96 feet, not far from the "Silver Blow," referred to in the same report in describing the "Queenslander."

From the bottom of the shaft a crosscut has been made for a few feet to south-south-west, and for about 30 feet to north-north-east across the direction of the lode. The last 20 feet of this crosscut is in the lode, which underlies to south-south-west. At the face there is what appears to be a footwall of quartzite, but the crosscut will have to be carried further before this can be taken as established. At the southern face of the crosscut there are soft clay shales. The lode in the crosscut consists of soft crumbling iron gossans, with carbonates of copper and lead.

An old level has been carried to east-south-east for 50 feet, and to west-north-west for 60 feet on the footwall side of the lode. A stack of ore, roughly estimated at 10 x 10 x 4 feet, has been raised from this level. Mr. Linedale informs me that it averages 20 per cent. of lead and 6 per cent. of copper, but is poor in silver.

About a quarter of a mile west-north-west a shaft has been sunk 20 feet, on the south side of the cap. A crosscut was made from the bottom across the lode. Mr. Linedale informed me that there was in the crosscut a thickness of about 4 feet of sulphide ore, giving 6 per cent. of copper, besides a large quantity of low-grade ore. About 200 tons have been smelted from this shaft.

Penzance.—The tunnel mentioned in my Report of 1891 has now become an open cutting or quarry, from which a considerable quantity of gossan ore, containing copper carbonates, has been taken. Mr. Linedale informs me that it gave from 6 to 10 per cent. of copper. A shaft has been sunk 40 feet from the level of the tunnel, and the bottom is connected by a level (north-west) with a crosscut from the 60-foot shaft referred to in my 1891 Report. The distance between the 40-foot shaft and the crosscut from the 60-foot shaft is about 80 feet. For the first 36 feet there are gossan ores in the level, and thence to the shaft chiefly sulphide ores, although the latter rise in one place above the level. The level is carried about 20 feet past the crosscut. Between the level and the 60-foot shaft the crosscut is mostly in a hard "dyke rock." On the opposite or south-west side of the level the crosscut is driven 20 feet through copper and zinc sulphides. The level is carried 50 feet south of the 40-foot shaft through copper gossan ores, which have been stoped out to a considerable extent. They yield 10 per cent. of copper and from 15 to 20 oz. of silver per ton.

A white limestone is seen overlying a portion of the ore deposit in the quarry. It penetrates downwards in a hollow or crevice, or

lies in a sharp trough, but it is distinctly not a *vein*, and equally distinctly is not interbedded with the ore-impregnated rock.

Griffith.—The "Magazine Face" has been greatly extended since I wrote my Report of 1891, having now being opened up for about 150 feet in length, and to a level about 30 feet below that at which I formerly saw it. There are great boulders of ore from top to bottom across a width of at least 20 feet. The great bulk of this ore is the sulphide of copper, locally known as "grey ore," with some red oxide and green carbonate. At least 3,000 tons of good ore are stacked, and from the occasional "blows" seen on the surface it is evident that the lode extends a long distance both ways.

A tunnel has been driven at the level of the bottom of the Magazine Face in search of the Nordville Lode. It has now gone 100 feet through limestone, calcareous greywacke, shales, and altered blue quartzites (?). It is calculated that the distance to the Nordville Lode is 50 feet more. Of this lode Mr. Skertchly said in 1896, "it yielded about 20 per cent. of copper. It seems to be a true lode running 100 degrees."

Lady Jane.—The Lady Jane lies between the *Dorothy* and *Griffith*. A shaft, which however there was no means of descending, has been sunk 40 feet. It was said to have bottomed on solid "grey ore." The small quantity of ore which can be seen at the surface is a grey sulphide with a reddish tinge and coated with green carbonate of copper.

Girofla.—The tunnel described in my Report of 1891 is now an open cutting, and indeed a great part of the hill has been cut down to that level, a large quantity of argenteriferous lead carbonates and iron oxides having been excavated.

DILLON'S CAVE.

I had little time on this occasion to go in search of the picturesque, but managed to devote a few hours of one night to Dillon's Cave, which is situated in the limestone cliff behind (north of) the town of Girofla. A maze of tortuous passages leads down and down, far below the level of the entrance, but there are no very large chambers such as adorn the "Temple" Cave, which I visited in 1890. One fine mass of stalactites is locally known as the Piano, from the musical sound which it emits when struck. "Organ" would be more accurately descriptive of its appearance. Some benches on the walls of the passages are evidently old water marks, and on these benches I could occasionally see fragments of a calcareous cave-earth full of fragments of small bones. The disappearance of bodies of water which evidently stood at different levels for lengthened periods may be explained in so many ways that a wide field is open to the imagination. I heard strange tales of the appearance and disappearance in a single night of bodies of water in hollows in the limestone. The systematic investigation of the bone-bearing cave-earths would probably yield results of great scientific value.

ARBOVIN MINES.

The camp is situated about 23 miles west-north-west of the town of Girofla, in the angle between Nondah Creek and the Walsh River. As the district is absolutely uncharted, I was unable to

locate the various mines except in the vaguest way in the course of a hurried ride from one to the other. Some idea, however, may be gathered from the bearings given and from the fact that each lease is supposed to occupy 20 chains along the line of lode. As the leases had not, at the date of my visit, been surveyed, the distances are probably only approximate.

The track from Girofla is fairly level, the total descent being perhaps 400 feet. First Welcome Creek is followed down, then Mundiva, Wandoo, and Poison Creeks, and one of the "Sandy Creek" family, and the camp is found on the left bank of Calligan's Springs Creek. As far as Poison Creek gneisses and schists are met with. Between Poison Creek and Sandy Creek a highly micaceous schist prevails. Gneiss and schist are met with all round the camp and the mines, the schist perhaps preponderating. Denuded ranges of Desert Sandstone are seen south of the road between Poison and Calligan's Creeks.

The "L" line of lode is west of the camp, and runs on the whole N. 30 degrees E. I did not see its extreme southern end, but commenced at the *Lamington* Lease. Here an open cutting on the left bank of Calligan's Creek shows a width of about 3 feet of "tile ore," siliceous and ferruginous "grey ore," and carbonate of copper. It is said to yield 30 per cent. of copper, while the rubble gives 6 dwt. of gold per ton.

The lode is traceable by outcrops of ore on a ridge running N. 30 degrees E. into an adjoining lease, the *P.P.A., No. 92* (just behind the camp). It then crosses the creek, and on a ridge on the right bank a trench shows the lode to be large and to contain good ore.

The next opening is in the adjoining *Ladrone* Lease. Here the ore seen *in situ* is about 6 inches across, but from the size of the blocks stacked it is evident that it has been much larger in portions of the excavation. It is of good quality.

The adjoining lease, the *Lebanon*, shows an outcrop of copper and iron gossan. A few hundred yards further, and to the left (north-west), a north and south lode has been stripped. It shows copper freely, and about a ton of good ore has been stacked. This lode underlies to the west at 65 degrees and is very straight and regular. It has a thickness of about 18 inches of visible ore.

Another north and south lode strikes off from the main lode a little further to the north-east. It shows copper freely, but has not been opened up in any shape.

In the next lease, the *Leghorn*, the yellow gossan gave an assay of gold equal to 3 oz. per ton (*vide* Linedale).

Further north, in the same lease, and west of the main line, a floor of ore is seen with a low hade to the north-west. Several tons of good copper ore have been taken from a shallow opening—"tile ore," siliceous "grey ore," and a little copper carbonate. The copper ore assayed 6 dwt. of gold per ton.

In the next lease, the *Leicester*, an opening in the main line (?) of lode shows a quantity of a greenish-yellow powdery ore, which is said to yield 10 per cent. of copper.

The next lease is the *Macao*. A shaft has been just commenced and about 2 tons of good copper ore have been taken from it. Two assays from here, Mr. Linedale informed me, gave respectively 32 dwt. and 17 dwt. of gold per ton.

The next (and last) claim on the line which I visited is the *Lytton*. No work has been done on it, but lumps of good ore are visible on the surface.

From the *Lamington* to the *Lytton* is about 2 miles, and over the whole distance (and some more besides) what appears to be a very strong lode can be followed on the surface, and is taken up in leases.

About a mile west-north-west of the *Lytton* is the *Mother* lode, which extends from north-east to south-west. The first lease on it which I visited is known as the *Leviathan*. Here a pothole has been sunk, and shows gossans, with a little phosphate (?) of copper. About half a ton has been taken out. The ore occurs in floors which underlie to the north-west.

The *Arrowsmith* Lease lies to the north-east of the *Leviathan*, but I was not able to visit it. Following the "Mother" lode to the south-west the next lease is the *Big Blow*, No. 8710. It has a large siliceous cap, but no work has been done, and I saw no ore.

A quarter of a mile west is the *Argosy*, a 40-acre lease. It shows large masses of rich copper gossans, which run north-north-east and underlie west-north-west. From an open cutting about 4 tons of gossan ores have been taken. In the same lease there are several other "blows" of good gossany copper ores. I was unable to determine how many lodes were represented by the different outcrops on the lease.

The *Perseus*, No. 810, adjoins the *Argosy* on the north-east. The cap of a large lode runs north-east and south-west.

The *Apollo* adjoins the *Perseus* to the north-east.

West of the *Apollo* is the *Great Seal*, No. 882, on the "Lost Watch" line of lode. Between the "notice" tree, on the *Great Seal* and the *Dominion Lease*, No. 837, which adjoins the *Great Seal* on the west, is the cap of a lode showing copper gossans.

South-west of the *Dominion* "notice" (to a water-hole) is a very distinct cap of a lode, showing fair gossany copper ores at intervals. Further to the south-west, on the same line of lode, is the *Yankee*, where a "blow" of good copper gossan and carbonate is seen.

The *Aurora*, No. 831, has a fair show of ore in a pothole. An outcrop of very good copper carbonates and gossans occurs between the *Aurora* and the *Yankee*.

Two miles east of the *Aurora*, and 2½ miles from the *Arbouni Camp*, is the *Nondah* (McLelland).^{*} This lease is said to be only a mile from the 94-mile telegraph post on Nondah Creek. (See Two-mile map.) The lode has a magnificent outcrop, at least 6 feet wide, full of thick masses of rich copper gossan ores.

The *Spaniard*, No. 887, is ¼ miles up Calligan's Springs Creek, and between it and Nondah Creek. It has a very large cap running N. 25 degrees W., and showing good copper gossans and carbonates all along.

^{*} In the application and early references to this lease it is spelt "Noondah," the intention having been to name it after the creek, whose proper name is Nondah. The latter spelling is now adopted.

ASHTONVILLE MINES.

Monte Video.—This mine is about 3 miles north of the Walsh River, and between Ashton and Bowler Creeks. A large gossan cap can be traced for a distance of about a quarter of a mile from N. 30 degrees W. to S. 30 degrees E., on both sides of a gully which runs south-westward towards Bowler Creek. The country rock is slate, greywacke, and quartzite, apparently vertical and with a west-north-west strike, and a bed of limestone is seen a few chains north of the southernmost workings.

At the northern end of the outcrop is a large "blow" showing lead and iron oxides, and some kernels of carbonate of lead. An open cutting from the south-west side has just touched the lode. A cutting on the line of the lode is driven N. 30 degrees W. from the right bank of the gully already mentioned. Some distance to the south of the gully an open cutting has been commenced running S. 30 degrees E., and discloses a small lode containing half-pound pieces of carbonate of lead and a little carbonate of copper. This is on the east side of the main outcrop, which consists of gossan. The last working to the south is an old shaft (inaccessible) said to be 60 feet deep, sunk apparently in country rock to the east of the line of the main lode, which, however, does not in this place make its appearance at the surface. The spoil-heap around the shaft contains a little gossan ore with some carbonate of copper.

Tartana Hill (P.P.A. No. 71).—This is an 86-acre lease, about a mile and a-half north of the Monte Video, and on the left or eastern bank of Bowler Creek.

North of the camp is an outcrop (*a*) of ore coinciding with the planes of bedding of quartzites, greywackes, and shales veined with carbonate of copper. These rocks are nearly vertical, and just at (*a*) they strike N. 15 degrees W., with a slight dip to W. 15 degrees S., but followed to the north they are seen to suffer violent flexures, and the outcrops of ore follow the twists of the bedding.

Less than a quarter of a mile to the east the country rises into a somewhat abrupt ridge, which coincides with the strike of highly inclined clay schists (N. 15 degrees W.). A tunnel (*b*) goes into the hill from the western side. It follows parallel veins of carbonate of copper, which cross the bedding-planes till, at 40 feet, it meets with a shoot of good ore, which for about 15 feet to S. 15 degrees E. (coinciding with vertical bedding-planes of clay schist) was worked up to the surface (36 feet) by a rise (*c*). The ore consists of the "grey" sulphide of copper and carbonates of lead and copper.

The tunnel (*b*) is continued for 20 feet further, crossing veins which coincide with the planes of bedding, and ends in a vein about 8 inches in thickness—"grey" sulphide of copper with copper carbonate and ferruginous gossan.

Further south, on the top of the hill, is a cutting (*d*) on a joint-plane vein and a shallow underlie shaft on another joint-plane vein which hades to east-north-east. The bedding planes all over the hill carry veins of carbonate of copper and "grey" copper ore and some red oxide of copper.

Down the eastern side of the hill, east-south-east of (*d*), is a shaft (*e*) known as the "Belle" on a pipe of good ore ("grey" sulphide and carbonate of copper). Its longer axis is east-north-east

or roughly speaking at right angles to the planes of bedding. About 5 tons of ore lie at grass—red copper oxide, "grey" sulphide, and iron gossan. Eleven tons have gone to the Chillagoe smelting works.

The whole country rock of the hill is veined with copper ore, representing a "stockwerk" in which some portions may be rich enough to quarry, while the veins look like "leaders," and probably emanate from a larger lode.

Masses of limestone are seen in numerous localities in the neighbourhood of the hill, and I have no doubt that the latter is a continuation of the Chillagoe country. It may be mentioned here that I saw near Bowler Creek an outcrop of limestone which, from its included bands of sandy impurities, was recognisable as having a true vertical bedding. Another instance was noted near Calcifer (where the strike was north-west and south-east). It is only in rare instances that the dip and strike of the limestone can be ascertained. The limestone outcrops are practically continuous from Girofla along the road *via* Rookwood Station to Ashtonville.

WANDOO CREEK.

I was informed by Mr. Linedale that silver and mica mines occur on the heads of this creek, but had not time to visit the locality.

MOUNT LUCY.

On the top of this hill is an enormous outcrop of exceedingly pure magnetite in which crystals containing as much as a cubic foot can be obtained. There are, I understand, some differences of opinion about the value of *magnetic* iron ores for fluxing purposes, but it may be mentioned that such ores were formerly brought from the Dry River and successfully employed at Montalbion. In any case the purity and abundance of the ore at Mount Lucy cannot be questioned. Mount Lucy would probably be the point of departure for a railway designed to connect the Chillagoe line with the Etheridge Gold Field.

MOUNT GARNET MINES.

The *Mount Garnet* mine is situated on the left bank of Return Creek, which is one of the largest affluents of the Wild River. It is generally reached by the dray road from Herberton through Coolgarra. I travelled from Koorboora by a dray road to Ord, on California Creek, and thence by the Herberton and Georgetown coach road to Cobb and Co.'s stables, on Campbell's Creek. From this point a bridle-track goes east-south-east to Mount Garnet. There is, I understand, also a direct bridle-track from Ord. I estimate the distance from Cobb and Co.'s stables to Mount Garnet at about 16 miles. It presents no engineering difficulties for a railway. The same may be said of the dray road from Koorboora to Ord, although I found it very rough from disuse and the accumulation of large boulders. I was informed by a local resident that the bridle-track from Ord to Mount Garnet is quite as easy as that from Cobb and Co.'s stables. The Mountain known as Mount Garnet lies a little to the east of the lode, which is on a comparatively gentle rise. The cap runs magnetic north and south. A tunnel, 170 feet in length, goes E. 17 degrees S., and is in ore from 111 feet to the face. Where the ore is first met with, at 111 feet, a winze has been sunk on it for 35 feet, and shows that it

has a slight underlie to the west. From 110 feet to 126 feet the ore is a mixture of oxides and carbonates of copper, and thence to the face it is sulphide. A drive goes S. 20 degrees E. from the tunnel, and is holed into the No. 4 Shaft, which is 67 feet deep. In this drive there is red "tile ore" and green carbonate of copper, with bands of copper pyrites. About half-way to the shaft a band of black sulphide comes in (zincblende with copper sulphide), efflorescing sulphate of copper. Near the shaft native silver can be seen freely on the surface of the blocks of ore. There is also a good deal of a decomposed kaolinic stone. A drive extends for 16 feet west of the bottom of the shaft through ore which is mainly oxides, with veins of carbonate and sulphide of copper at the face.

Returning to the tunnel, between the drive and the face native silver is visible in red oxides, immediately beyond the drive. The red oxide ("tile ore") changes to sulphides consisting of copper pyrites and erubescite. At the face the ore is almost solid sulphide, and there is no sign of the wall of the lode having been reached. Native silver can be seen in moss-like spots on the ore in the face. The country rock at the mouth of the tunnel is a decomposing elvan. The old shaft, known as No. 2 West, is on the cap of a lode which runs parallel to the lode met with in the tunnel and in No. 4 Shaft. The lode underlies to the west. It is in a country rock of hard altered quartzite (?). This lode is probably represented by a copper-stained quartz met with in the tunnel 30 or 40 feet from its mouth. The ore from No. 2 West Shaft may be good for 5 per cent. of copper and is said to go well for silver.

No. 3 Shaft is $9\frac{1}{2}$ chains north of No. 4 and 150 feet east of No. 2 West. It is 105 feet in depth. There are some 150 tons of very fair carbonates of copper at grass, and perhaps twice as much of ferruginous and siliceous oxide ore, and a small heap of zincblende and arsenical pyrites. The top of the shaft is a little below the level of that of No. 4 Shaft. No. 3 Shaft is 11 by $6\frac{1}{2}$ feet, and sunk entirely through ore. At 75 feet there is a drive to the west for 15 feet through poor ore to a wall of porphyry, and for 75 feet to the east through copper-stained iron oxide, with green soapstone heads, which underlie to the east and contain lenticular masses of quartz. The face is still in the lode. Eighteen feet from the shaft a drive goes to the south for 33 feet through a green steatite containing red and black iron oxide, but not much copper. In the shaft there is little copper ore to speak of between 75 feet and 90 feet, but from 90 feet to the bottom there are gossan ores in which carbonate of copper shows up fairly well. At the bottom there is not so much carbonate of copper, but more pyrites and zincblende.

Between the No. 3 and No. 4 Shafts the cap of the lode is large, and consists mainly of an iron-stained siliceous "skeleton." Very little copper is seen.

Another hole has been sunk $10\frac{1}{2}$ chains south of No. 4 Shaft on a well-marked "blow" of the cap. It shows copper stains on a quartzitic stone, which I take to be lode matter. Two and a-half chains further, between the boundary and the fence, the cap is seen in a gully with slate country on its east side. This, I understand, is in a lease held by Mr. R. Bedford.

Further north, beyond the gully, an old shaft has been sunk 60 feet deep in aluminous rock, just south of a large "blow" of the cap of the lode. The aluminous rock has bits of blue carbonate of copper mixed with it, but not in great quantity. Gold is said to have been got in this shaft by the men who sunk it. My informant said that three assays in Brisbane had ranged from 5 to $7\frac{1}{2}$ dw't. per ton.

About 50 feet to the north is No. 1 Shaft, 30 feet deep, in a hollow in the cap of the lode. An excavation representing perhaps the removal of 1,728 cubic feet has been made between the two shafts, and a heap of ore lies abreast which would just about fill it. This ore is siliceous and ferruginous, and is stained with carbonates of copper and lead ochre, with some kernels of carbonate of lead. The whole might go 7 per cent. of copper. North of the No. 1 Shaft, the broad siliceous bands which crop up at the surface run N. 20 degrees W., but my impression is that they are all portions of the large north and south lode.

The cap of the Mount Garnet lode is strong and persistent, but gives little indication of the immense body of ore which has been met with beneath. I could not help reflecting that a great many of the Chillagoe and Arbouin lodes are equally strong and persistent, and show a great deal more ore at the surface.

Campbell's Lease (Jessie's Dream) is half a mile west of the Mount Garnet mine. A siliceous "blow" showing carbonate of copper runs S. 30 degrees E. through a country rock which I take to be an altered quartzite.

Dowel's Lease is a quarter of a mile east of where the Mount Garnet lode crosses the gully at the south boundary of the Company's Freehold. At the fence there is to be seen an outcrop of a siliceous and ferruginous "skeleton," exactly of the same character as that of Mount Garnet itself.

Further to west-south-west, across a gully, a trench, 5 feet deep, shows a gossan containing a good deal of carbonate of copper together with decomposing carbonate of lead, manganese oxide, and pyrites. The lode apparently runs S. 12 degrees W., and ore can be seen for about 25 feet. Another trench is being opened on it about 100 yards S. 12 degrees W., and shows a ferruginous gossan which is very heavy and probably contains lead.

About 175 feet W. 20 degrees S. of the trench last mentioned, another prospector is trenching on a gossan cap, which shows a micaceous iron ore and some kernels of carbonate of lead.

Six hundred feet further south, a trench is being opened on a gossan "blow," containing some very pure iron glance.

Cardwell (W. S. Dowel).—This is a 40-acre lease lying 2 miles east of the Campbell's Creek Coach Stables. On the top of a hill is a very large ironstone blow, which runs E. 30 degrees N., and is apparently not less than 70 feet wide. It is, in part, a pure magnetic iron ore, and in part only a siliceous skeleton. An old shaft has been sunk close to the northern side of the cliff, for 40 feet, in granite country. Below the mouth of the shaft is a cutting running towards the lode for about 15 feet, with apparently about 30 feet more to go to reach the lode. The part of the ironstone cliff towards which this cutting points is copper-stained. Another opening on the south side

of the line of lode discloses some "tile ore" and carbonate of copper mixed with iron glance and micaceous iron ore, and a little "peacock ore" and "grey ore."

A new open cutting has been commenced in the granite, and has been carried towards the lode on a bearing of S. 30 degrees E. The cutting is to be continued as a tunnel, and it is calculated that it will strike the lode in 160 feet, at a level of about 100 feet below the summit. I should not be surprised if the Cardwell should turn out an important copper mine.

LYND RIVER, FOSSIL BROOK, ELIZABETH CREEK, JUNCTION CREEK, EINASLEIGH RIVER.

The Herberton-Georgetown coach road between Campbell's Creek and the Lynd is on an unbroken mass of granite. Immediately after crossing to the left (or western) bank of the Lynd, however, the granite is overlaid by a sheet of basaltic lava, which has evidently flowed down the valley. Before the township of Fossil Brook is reached, the road gets down again to the granite, and the latter is shortly afterwards replaced by a micaceous gneiss. The township is almost deserted, although it supported three public-houses a few years ago, when the (stream) tin mines on the Fulford and Lancewood were in full swing. The former are about 15 miles to the north-west, and the latter about 25 miles to the south-west. The man in charge of Cobb and Co.'s stage showed me about a hundredweight of fair copper carbonates which had been brought a few days previously, from about 5 miles off, by an aboriginal who had been shown a specimen of copper ore, and affirmed that he knew where there was "plenty of the same stuff."

From the township the road goes southward, up the valley of Fossil Brook, to nearly opposite Springfield (Williams's) Station, a distance of about 12 miles. This part of the road is nearly level, and the rock *in situ* is mostly micaceous gneiss, although granite hills skirt it a little to the west. From the divide between Fossil Brook and the "Twelve-mile Creek" (a tributary of Elizabeth Creek) the road resumes its south-west course. The road crosses a wide sheet of basaltic lava in the valley of the Twelve-mile Creek, and granite for the remainder of the distance to Quartz Hill. Basalt again occupies the bed and valley of Elizabeth Creek. Between the Quartz Hill Hotel (which is on the left or southern bank of Elizabeth Creek) and Junction Creek the road crosses several successive beds of lava, the highest of which is locally known as the "Wall," and stands up sometimes to a height of 40 or 50 feet. The basalt apparently covers the whole plateau between Elizabeth and Junction Creeks for some distance, as it comes down to the right (or northern) bank of the latter stream, near the western boundary line of the squatting block, "Brookland No. 3."

I left the road at Brookland Station (Collins's) on the right bank of Junction Creek, and guided by Mr. E. O'Brien, an old prospector, zigzagged down the valley of Junction Creek to visit a number of "shows" recently taken up.

Before leaving the station, Mr. O'Brien showed me specimens of bismuth, wolfram, and mica, which he said were all obtained from the neighbourhood. One plate of mica measured 7 inches square. The rocks at the station are gneiss and mica schist.

At a point (*a*) which I estimate to be 2 miles south-west of the station, some carbonate of lead and calcite were seen between the north and south bedding-planes of an outcrop of mica schist.

At (*b*), on the right bank of Junction Creek, just below the edge of the basalt near the western boundary line of "Brookland No. 3," is the cap of a lode which runs east and west (magnetic), and shows bands of lead and copper carbonates, each about 18 inches in width. This seems rather a promising lode, and is traceable on the surface for about 80 yards.

On the opposite side of the creek, and almost in its bed, a large rock (*c*) of mica schist is slightly impregnated in parts with carbonate of lead and a little carbonate of copper.

On the same (left) side of the creek, half a mile below the boundary-line between "Brookland No. 2" and "Brookland No. 3," is the distinct siliceous cap (*d*) of a lode which is traceable for two chains from north to south. A hole, 4 feet deep, shows carbonate of lead and a little carbonate of copper on a face of gneiss.

Half a mile south of the left bank of the creek, and nearly opposite the eastern boundary of "Brookland No. 1," in gneiss country, is the cap (*e*) of a lode, about 6 feet wide, but traceable for only a few yards. It shows parallel veins, up to 18 inches thick, of fairly good carbonate of copper, and a little "grey" sulphide ore.

Half a mile from the right hand bank of the Einasleigh River, and about midway between the mouth of Junction Creek and the crossing of the Herberton-Georgetown coach road, is an outcrop (*f*) of siliceous lode matter (running east and west?). It is only visible for about 8 feet, and its direction is uncertain. In one place it contains about 3 feet of solid lead carbonate, and the same ore is disseminated more sparsely throughout the remainder of the siliceous matrix.

Until the outcrops described under the distinctive symbols "*a*" to "*f*" are somewhat opened up, and their copper, lead, and silver contents estimated by assay, it would be rash to say whether they are of any value; but they at least prove that the whole of the country between Brookland Station and the mouth of Junction Creek carries copper and silver, and may be worth prospecting.

"LYND" COPPER MINE.*

After having camped for a night at the coach stage at the Einasleigh crossing of the Herberton-Georgetown road, I was guided up the river to the "Lynd" Copper Mine by Mr. O'Brien. The journey was on the whole devoid of incident or interest. As far as the south-east boundary of "Brookland No. 2," the country on the right bank of the Einasleigh River consisted of gneiss with large quartz reefs, and was nearly level. The old Etheridge-Palmer track can no longer be detected. From "Brookland No. 2" to the 109-Mile Tree the country is gneiss.

* The naming of this mine has been unfortunate. It is situated on, or rather in, what is now known as the Einasleigh River, but which Daintree knew as the Lynd. Many still hold the opinion that the Einasleigh is really the river originally named the Lynd by Leichhardt, and that the river now known as the Lynd is not entitled to the name. I am informed that the mine is now to be called the Daintree, which will be misleading, as the public will be apt to suppose that it is situated on the Daintree River.

At 108 miles a patch of basalt occurs on the right bank of the river. Granite occurs at Jardine's Lagoon, and apparently continues southward in the range of hills which extends to Mount Mistake. Our course kept to the east of this range by easier travelling, on a bottom composed of gneiss and occasional mica schist, crossed the Einasleigh from right to left about a mile above its junction with the Copperfield, crossed the basalt flat between the two rivers, and finally crossed the Copperfield and followed its left bank down to the point where it falls into the Einasleigh. The basalt crosses the Copperfield, and occupies the valley of the Einasleigh, as I am informed, for about 15 miles down.

The course of the Einasleigh, after it has received the Copperfield, is nearly due north. In the bed of the river the rocks are gneisses, schists, and shales, vertical or nearly so, and striking N. 25 degrees E. (mag.). On the left bank is a sheet of basaltic lava, 30 or 40 feet in thickness. The cap of a lode is seen beneath the bank, and is traceable for 180 feet to N. 15 degrees W., when it disappears under the basalt. I took its width to be 40 feet, and should roughly estimate that the ore visible (mainly carbonate) would go at least 10 or 12 per cent. of copper. Further south, and further north, veins of magnetic iron ore, containing carbonate of lead and copper, coincide with the foliation of the schistose rocks. The account given by Mr. Richard Daintree, formerly Government Geologist, which was communicated by the Rev. W. B. Clarke to the Royal Society of New South Wales in 1867, states that a shaft was sunk on the lode, and that a drive at the 30-foot level showed the lode to be 23 feet in width, and to consist of "spongy metallic copper." Even "metallic copper," in the remote region in question, it appears, could not be mined and transported with profit. With a railway to or near it the case will be very different.

From the Einasleigh I travelled rapidly, *viâ* Georgetown and Croydon, to Normanton, at which port I caught a steamer for Brisbane. This part of the journey has already been described by me,* so that it is unnecessary to repeat it.

ENINASLEIGH HOT SPRINGS.

Having reached the confluence of Junction Creek with the Einasleigh, I crossed to the left bank of the latter, and visited the hot springs. A description of the springs is given in "Geology and Palæontology of Queensland and New Guinea,"† and need not be here repeated. The chief interest of the last visit lies in the comparison which I was enabled to institute. The volume of water was less and the temperature was lower, and, strangest of all, the quality seemed to have changed. Whereas on the previous visit I referred to the taste as "indescribably nasty" ("essence of decayed fish" was the phrase which ran in my mind) on this occasion I found it practically tasteless.

I had provided myself with soap, and made the experiment of throwing it into the spring. The spring was certainly excited, but not to the point of producing an explosion of the sort which is known to be

* Geological Observations in the North of Queensland. Brisbane: By Authority, 1887.

† "Geology and Palæontology of Queensland and New Guinea." By Jack and Etheridge. Brisbane: Government Printer, 1892.

effected by "soaping" the geysers of the Yellowstone National Park. Evidently the temperature of the water was not high enough. Mr. Collins, of Ambo Station, informed me that the volume of water comes and goes with the seasons, and that an hotel was erected a few years ago for the benefit of invalids, but the invalids were not forthcoming in sufficient numbers, and it was removed.

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